A L S

The Advanced Light Source (ALS) at the Lawrence Berkeley National Laboratory (LBNL) is one of the world's brightest sources of soft X-rays and ultraviolet light. ALS is the first U.S. member of a third generation of synchrotron light sources that employ advanced accelerator and magnet technology to produce X-ray beams so bright they resemble the hair-thin beams from lasers. ALS – which began operating in October 1993 – offers unprecedented opportunities for research by American scientists from industrial, academic, and government laboratories.

ALS features an electron storage ring that is about 650 feet in circumference. In it, electrons circulate many hours while they emit synchrotron radiation. The keys to the high brightness of ALS – about one billion times brighter than from conventional X-ray tubes – are the tightly focused beam in the storage ring and the precision-engineered insertion devices that deflect the electrons back and forth many times, thereby dramatically enhancing the emission of synchrotron radiation. Up to 10 insertion-device and 36 conventional beamlines can be arrayed around the storage ring to guide and focus the X-rays simultaneously to some 100 experimental stations.

The Advanced Light Source at Lawrence Berkeley National Laboratory generates breakthrough results in such fields as atomic and molecular physics, materials and surface sciences, biology, chemistry, and microfabrication.

Soft X-rays are an ideal tool for probing the secrets of matter at the level of individual atoms and molecules because they can penetrate samples and, according to their wavelength, interact with their atoms and molecules.

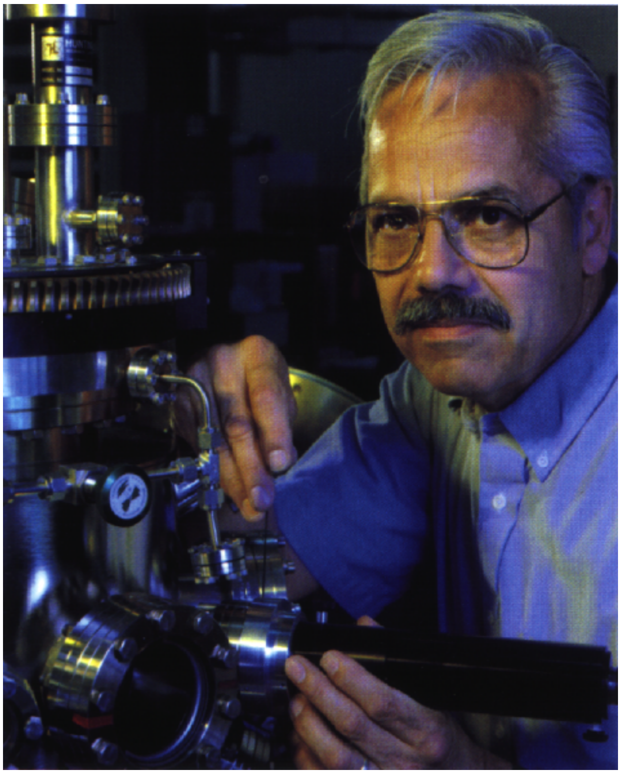
Potentially, research will cover an exceptionally wide range of areas – both fundamental research and new technologies – from semiconductors, the foundation of the electronics revolution, and magnetic materials used in computer-storage disks, to molecules undergoing rapid reactions in combustion and other industrially important processes, and structures within biological cells that determine how well drugs can fight disease-causing agents. such as viruses.

ACCOMPLISHMENTS

Scientists demonstrated the ability to map the distribution of radioactive isotopes of elements in microsamples with so little radioactivity that they can be handled safely; this could provide a greatly improved way to chemically analyze materials from nuclear waste sites without hazard.

A team of researchers developed an interferometer using extreme ultraviolet light at wavelengths lying between those of ultraviolet radiation and X-rays to test mirrors and lenses that are

ADVANCED LIGHT SOURCE



George Castro of IBM's Almaden Research Center led the commissioning of a photo-electron microscope at the Advanced Light Source that produces images of solids and their surfaces by means of the electrons emitted when a sample absorbs X-rays.

candidates for use in manufacturing future generations of computer chips.

ALS is collaborating with several Silicon Valley companies to test techniques that combine spectroscopy with microscopy (spectromicroscopy) to monitor computer chips during fabrication for contaminating microparticles, and to analyze failure-causing defects, such as breaks in the current-carrying lines that connect transistors.

Chemists are using the ALS to study in detail the chemical reactions occurring in the combustion processes that are major sources of pollution and in the atmospheric processes that bear on the problem of ozone depletion.

Visiting scientists achieved a world-record spectral resolution in their atomic-physics experiments on helium gas, a well-established test bed for detailed examination of how electrons interact with each other.

Researchers from several institutions are using an X-ray microscope designed at LBNL to image the interior of biological structures, such as the distribution of DNA in the form of chromatin strands in sperm cells, at high resolution without staining or other preparation techniques that can alter the structure before viewing.

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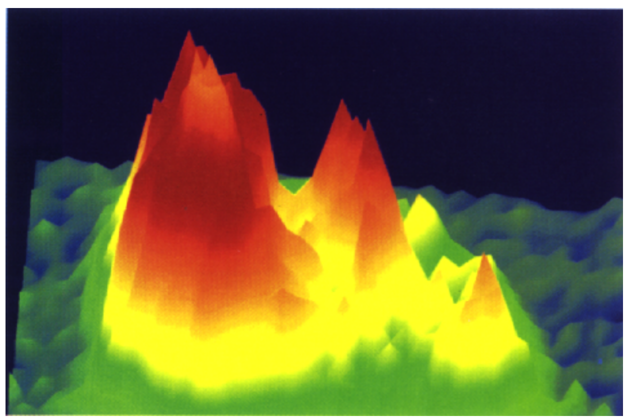

Image of a contaminating chromium particle in sediment from the San Francisco Bay illustrates how the ability of the ALS X-ray microprobe to analyze trace amounts of material with high spatial resolution can contribute to environmental remediation efforts.